GAS JOURNAL

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HYDROGENATION

THE choice of the subject of hydrogenation for this year's Melchett Lecture, given to the Institute of Fuel last week, was fully justified by its importance in the fuel and chemical industries as well as by its particular interest to the Gas Industry at this juncture. And the choice of Mr. Kenneth Gordon as the lecturer was a happy one in view of his immense knowledge of and experience in these processes, upon which he has already presented two important papers dealing with recent progress at home and abroad. He covered in general terms the whole of the utilization of hydrogen under pressure in the (coal) fuel, petroleum, and chemical industries, with the manufacture of hydrogen, its mixtures with nitrogen in the production of synthetic ammonia, and with carbon monoxide for making synthetic methanol and other purposes. The latter leads to processes involving reactions between carbon monoxide and hydrogen and the Fischer-Tropsch process, and finally to a wide variety of hydrogenation processes for converting coal tar and petroleum to hydrocarbon products—one might also say, so highly developed are they—for the *selection* of whatever hydrocarbon compound is required.

The gas engineer will be perhaps most interested, first, in the manufacture of hydrogen, and secondly, in such processes as the Fischer-Tropsch. The usual method in this country, where bituminous coal is the raw material, is to gasify it by a combination of carbonization and water gas manufacture and then to use the carbon monoxide to obtain more hydrogen by reaction with steam over a catalyst. It is, perhaps, because the users of hydrogenation are already associated with concerns employing coke ovens that this is the form of carbonizing plant in their minds. The lecturer sees two objections to it; first, that the supplies of coking coal in this country are not too large; and, second, that both the carbonizing and the water gas processes are intermittent, with consequent high cost and low thermal efficiency; with a third reason, that there is loss of heat consequent upon the cooling of the coke from the oven before it is fed to the water gas generators. All three of these difficulties would, it would seem, have been overcome if there had been more consultation with the Gas Industry. The continuous vertical retort with steaming would greatly extend the range of coals which could be economically used; the loss of heat in cooling the coke is entirely obviated; and the carbonizing process at least is continuous with, one would think, a lower overall cost and certainly a higher thermal efficiency. There is a further advantage in this use of Gas Industry processes. The gas, resulting from steaming to the economic limit, using a portion of the water gas to heat the retorts, is a mixture rich in hydrogen and carbon monoxide, and these in approximately the correct proportion for the "conversion gas" required in the Fischer-Tropsch process.

From the rest of the lecture—that is, the greater portion of it—the gas engineer will note one or two points. The removal of sulphur compounds from the conversion gas is of high importance. The old-established iron-oxide box is still the only practicable method. Who will not sigh with agreement with the remark: "It is time there was some more elegant method of carrying out this part of the process"? Carbon dioxide is removed by scrubbing with water at pressures between 10 and 100 atmospheres and the gas is recovered on release of pressure with 92% purity. Residual carbon monoxide is removed by scrubbing with a solution of ammonium carbonate or formate or by nickel catalysis at 200°C. into methane. The lecture ended with a section on the manufacture of iso-octane and other fuels for internal combustion engines, such as those used in aviation, which are of general though not immediate interest to the gas engineer.

ANTICIPATING AND RESPONDING TO DEMAND

A GOOD plan embraces not only a scheme which may give pleasure by virtue of its theoretically sound construction, but a project with a definite practical purpose in mind, fostering hope for the future. An example of planning in its best sense is to be found in the link-up between gas manufacture and supply in the area surrounding Lydney, Glos. Its logical construction should be of interest to the Gas Industry. The new system of integration is of the greatest importance to the industrial development of the area—a development the outcome of the sudden growth of new factories within a comparatively small radius of Lydney. The first stage of this industrial expansion, the provision of a new carbonizing plant, was celebrated on October 9. A full account of the plant and the pleasant social atmosphere surrounding its release from the manufacturer's trial period is contained elsewhere in this issue. We congratulate Mr. C. H. Chester, O.B.E., and his fellow Directors of the Lydney Gas Company on an ambitious and far-sighted plan.

The first step was the building of a modern intermittent vertical carbonizing plant and ancillary plant at Lydney; this has doubled the gas-making output of the works and will, without further extension, supply the Coleford area. The extension of supply was scheduled in four phases, the first being the laying of a main to the Lydney Industrial Estate, which was completed early this year. The second phase, which is scheduled for completion early in 1948, consists of a high pressure main of 8 miles length from Lydney to Whitecroft, Bream, and Coleford, and on its completion the Coleford Works will be closed down as a manufacturing station and used as a storage centre. The third

phase will consist of a ring main round the Coleford district to supply Broadwell, Lane End, Coalway, Berry Hill, and Christchurch. Finally, a feeder main will be connected at Whitecroft to supply Blakeney via Pillowell and Yorkley.

The way in which the general development of the area has linked up with the Lydney Gas Company is without neither interest nor significance. The Royal Forest of Dean Development Association, formed to plan against the gradual decline of the forest mining industry, had been endeavouring to secure industry for the areas of West Dean, East Dean, and Lydney, and the Board of the Lydney Gas Company has co-operated in this project in a thoroughly practical manner. The scheme is logical and has been planned to tie up with adjoining areas under a broader scheme, for which plans have been submitted and tentatively approved by the Ministry of Fuel and Power. Here is a further example—small in itself, admittedly, but, as we have suggested, having wide significance—of rational integration.

A TALK ON FUEL ECONOMY

SIR ERNEST SMITH is a busy man ; all the more reason therefore why the Midland Junior Gas Association, who were joined on the occasion by the Wolverhampton and District Engineering Society, should feel gratified that he should consent to give them a talk last week on the all-important subject of fuel economy in its broadest sense. The October issue of " GAS " will carry our report of the Address, but we should like to refer to a few points from it here. In short space Sir Ernest covered a surprisingly wide field with his usual freshness and frankness of outlook, though by virtue of the brief time at his disposal and the varied interests and qualifications of his audience, his remarks were of a general rather than a technical nature.

Certain points in the Address, though disconnected when lifted from their context, impressed us as being of particular interest. There was, for example, the criticism that among the technicians of our Industry—and presumably this applies to other industries equally—there are too few administrators. That is to say, the scientific workers who live by theory or blueprint alone have insufficient contact with or knowledge of handling men. He pleaded, and in our opinion rightly, for an increased interest in the next man's job, and, resulting from that, greater ability to make authoritative decisions. Again, Sir Ernest brought to attention the disastrous part played by the inefficient stoker who, with a complete failure to grasp the essentials of accurate boiler work, could quickly wreck an expensive installation. There was, he said, a great need for boiler firemen to be given a proper course to acquaint them with the do's and dont's of steam raising, following which they should be awarded a certificate and their pay should be raised accordingly. It is significant that in South Africa no one is allowed to fire a boiler without the necessary qualifications.

Considerable stress was also laid upon the thinning ranks of miners, the dying out of the old mining families, and the increasing reluctance of men from other trades to consider mining as a career, due presumably to improved education and higher standards of living. In this question of getting ample supplies of coal, Sir Ernest said, it was probably true that many who discussed the subject under-estimated what the miner himself could do if only he had the right attitude. For years past, the standard policy of the unions was to discourage high outputs, and the chief trouble with the miner was that he was afraid of unemployment being as bad as it was between the wars. Sir Ernest said the cure for their present ills lay not so much in mechanization, to which there were distinct limits, but in the fostering of a team spirit in the pits and the gaining of the miners' confidence. And he urged that the present distant control of the mining industry should be replaced or supplemented by a more intimate and personal contact.

These and many more aspects of the fuel problem were discussed and we feel that by bringing their message into the midst of associations and societies in this way, those who spread the message of fuel saving will double the chances of success.

Commentary by "Abaris"

Circumspice

One of the best forms of publicity we have lies in our gas-works. First, the works stick out a mile and are well known as landmarks, to a greater or lesser degree; and second, we can show dramatically to hand-picked members of societies, how the world's best fuel is made. But there are certain fundamentals we must adopt before really organizing visitors to works. I have been on many works and very rarely has the drill been systematic or the story coherent and well told.

The first move, I suggest, should be to a room or hall where a blackboard can reveal the outline of the gasmaking process. This is explained to the party, with a phrase or two about our history, after which *exeunt omnes*, as the dramatists say, to the retort house or what you will.

This brings up point two: the good earth trodden by your pilgrims should not be inches deep in mud, or tar, because the modern shoe, trouser, silk stocking, or boot are jointly and severally hard to come by. Spoilt apparel means spoilt visits. Let the perambulation, therefore, be as clean as possible for the enthusiasts who are keen enough to want to set foot on your premises.

The guide, and may the souls of some I've heard, shrivel, must be concise and lucid; there are hours wasted by the recondite gentlemen who whisper about fractionation, waste heat boilers, non-recuperative retorts, and the like, without telling hapless hearers what each is. Many guides get their victims by a coke screen in full blast and endeavour to make themselves audible; some appear to resent questions by the listener; several lack a sense of humour. Good talkers with pleasant appearances are plentiful, if they are sought out; enthusiasm and knowledge can be blended also to make a really first rate guide. Our story merits only the best tongues in the telling.

Teachers

One of the greatest difficulties now being encountered by those trying to operate the Institution's Education Scheme is, I am told, the provision of suitable teachers. The problem is not being made any easier by the fact that one large technical college has recently thought fit to *reduce* the scale of fees paid to part-time evening class lecturers.

An authority on part-time teaching tells me that few teachers of gas subjects are paid more than 1½ guineas for a two-hour period of instruction; the majority are paid only one guinea, some as little as 15s.

Now the men of experience, knowledge, qualification, and ability to teach are commanding salaries for their normal employment in the Industry which leaves them no desire to go out at night to earn an extra guinea. As one such teacher tells me, he pays income tax at the standard rate of 9s. His fee of 21s. is thus subject to P.A.Y.E. and he therefore receives 12s. 2d. He estimates that the cost of a substantial meal (necessary because he cannot reach home after his his lectures until nearly 11 p.m.), the cost of running his car to the technical college, and the cost of some liquid refreshment afterwards which, he assures me, is necessary to wash the chalk dust out of his throat, more than absorbs this 12s. 2d. He has come to the very definite conclusion that " this teaching business " is a labour of love. Added to all this he is expected to take home and mark students' homework and must, perforce, spend several hours of his leisure time preparing his lectures. Any précis notes, sketches, and the like for issue or loan to students must be produced at his personal expense, there being no means of re-imbursing him from public funds.

It can easily be appreciated that, under these conditions, the senior technical executives of gas undertakings—the men who ought really to be passing on their knowledge and experience to the next generation —are not interested in such meagre fees; in fact, it is considered by some to be beneath their professional dignity to accept " a quid a night." And remember, although this paltry fee is for a class of two hours' duration, the lecturer, like his students, can call it a night since, as in the case of my informant, it is usually about 10 or 11 p.m. before he eventually reaches home and he is not able to keep any other engagements on the nights he is teaching.

What, then, is the result ? It is, I suggest, that a lot of third-raters are taking on this important job of teaching. They are the low-

salaried men to whom the guinea per night is a substantial attraction. They have not yet reached the higher rate of income tax and hence obtain a large proportion—if not all—of the fee. I believe a few of these younger teachers are very good, especially those who have attended courses in methods of instruction and know how to teach in addition to knowing their subject. But the fact remains that they form a very small minority.

If the Institution's Education Scheme is to continue as the basis for providing properly qualified gas engineers something must be done quickly to obtain the payment of suitable professional fees and to ensure that only those fully qualified to teach are permitted to do so. I believe the former will prove the solution to the problem and the latter will follow as a matter of course.

1430

To historians the year 1430 A.D. may mean a stirring chapter in the annals of mankind. In Great Britain it marked the ninth birthday of King Henry VI, who came to the throne at the tender age of nine months; just after his first anniversary, he succeeded to the throne of France. This prodigy made public appearances when he was two, and even took his place in Parliament. But I digress.

1430, as we all now know, is the code number of Radiation's latest cooker, a comely, gracious, and upstanding product with an undeniable appeal. The fair sex will regard it as desirable, if I may use such a novelesque word, in the kitchen which it would embellish, and at reasonable cost.

The oven is an honest, frank space that will clean with the proverbial wipe, because it contains no edges and slots to trap the drops of fat that inescapably drape themselves about the interior of the usual oven. Easy clean is well applied to the smooth externals and internals which gleam gratifyingly.

Some diamonds have flaws be they never so carefully cut, and I personally do not care for the door handle, and I think that the taps are on the small side, particularly for fingers that are no longer as sensitive and as lissom as they were.

These, as I have said, are personal impressions of this excellent cooker, which I am sure my wife would like to possess; if I criticize it is because I am critical by nature, but I, too, would be happy to cook on and in No. 1430. Let my last word concern the booklet that Radiation issued when they revealed the 1430. It is a delight to read and to handle.

Patents

We are not disposed to read and to try to digest the various Patents and Designs Acts. Most of us are never likely to invent anything but threadbare excuses, so the subject of patents is foreign to our simple natures. I can commend to those who have inventive minds, the final Report of the Departmental Committee on Patents and Designs, Cmd. 7206, price 1s. 6d. Not the least interesting observations are directed to the position of the inventor-employee in private employ, who, at present, has little protection in the matter of any patent he may take out for an invention.

An employee—in the Gas Industry, for example—may patent, say, a new type of window frame which to all intents and purposes has no bearing directly on gas making. Here, the patent is obviously the employee's and his employer would have no claim.

The employee, on the other hand, who is hired to use his skill in solving a particular problem, is in a very different boat, for a patent connected with that problem should, by rights, be owned by the employer. A dispute would have to be taken before a Court, at considerable expense.

The third possibility envisages a case in which the employee and the employer both may be entitled to share in and derive benefits from the invention.

The three examples given above are quoted where no agreement has been signed by the parties concerned; the report considers that High Court actions are too expensive and protracted, and that disputes should be more easily settled by the Comptroller, with the right of appeal to the Patents Appeal Tribunal.

In view of the threat of nationalization, the recommendations of the report are of interest where they deal with the Government Department inventor. Departments have hitherto dealt in different ways with inventions within their gates. Apart from pointing out that one method is desirable, the report suggests that inventions should be treated as public assets and vested in a single body; furthermore, all inventions should be exploited abroad, where possible.

Miss Maywen Godby, of the Women's Gas Council, opened the Nottingham Gas Department's Homecraft Course on Oct. 7, with a lecture and film dealing with kitchen planning. The course consists of 10 lectures in all, and is being held in the Gas Department's Theatre, 106 people attending the first meeting.

Personal

Mr. P. N. LEE, Middlesbrough Corporation Gas-works Superintendent, has been promoted to the position of Works Engineer.

* * *

Mr. F. M. BLAKE, of the Davis Gas Stove Co., Ltd. (Radiation, Ltd.), has been appointed Assistant Sales Manager of the Company.

* * *

The Directors of the Lochgelly Gas Company have appointed Mr. A. NISBET to be General Manager. Formerly he was Commercial Manager, and Mr. ALEX. MCNEILL Works Manager. The latter has secured an appointment at Cupar. Mr. Nisbet has been with the Company since his youth.

* * *

The Leon Gaster Memorial Premium, awarded annually by the Illuminating Engineering Society for the best contribution submitted to and published by the Society during the session, has been awarded this year to Mr. J. S. SMYTH for his Paper on "The Brightness and Legibility at Night of Road Traffic Signs."

* * *

The Lord President of the Council has appointed Professor P. I. DEE, C.B.E., F.R.S. (Professor of Natural Philosophy at the University of Glasgow), and Sir WILLIAM GRIFFITHS, D.Sc., F.R.I.C., F.Inst.P., F.I.M. (Chairman and Managing Director of the Mond Nickel Co., Ltd., and Past President of the Institute of Metals), to be members of the Advisory Council for Scientific and Industrial Research from Oct. 1. Professor Sir LAWRENCE BRAGG, O.B.E., M.C., D.Sc., F.R.S., Professor Sir JOHN LENNARD-JONES, K.B.E., D.Sc., F.R.S., Sir ANDREW MCCANCE, D.Sc., F.R.S., and Sir RAYMOND STREAT, C.B.E., retired from the Advisory Council on completion of their terms of office.

Obituary

The death has occurred at the age of 53 of Mr. NINIAN YULE, Director of the Armadale Gas Company.

* * *

For many years Editor of *Chemistry and Industry*, the death occurred on Oct. 12 of Dr. STEPHEN MIALL, after a short illness, at the age of 75.

Diary

Oct. 24.—Women's Gas Council: Liverpool Gas Company, 2.30 p.m. Address by R. J. Gregg, Sales Manager, Ascot Gas Water Heaters, Ltd.

Oct. 25.—Western Junior Gas Association: Meeting at Bath, 2.30 p.m. Paper by R. Miller on "Gas Oil in Horizontal Retorts."

Oct. 28.—Southern Association of Gas Engineers and Managers: Annual General Meeting, Connaught Rooms, Kingsway, London. 2.30 p.m. (Council Meeting, 11 a.m.)

Oct. 31.—Manchester District Association of Gas Engineers: Autumn Meeting. "Four Years' Developments at Preston," A. K. Collinge. Midland Hotel, Manchester.

Nov. 5.—Institute of Fuel: Meeting of London Section, Institution of Mechanical Engineers, 2.30 p.m. Paper by D. Hicks on "The Coal Resources of the Country."

Nov. 5.—London and Southern Junior Gas Association: Visit to the Letchworth Works of the Sigma Instrument Co., Ltd. 2.30 p.m.

Nov. 6.—Eastern Association of Gas Engineers and Managers: Autumn Meeting, Waldorf Hotel, London, 1.45 p.m. Presidential Address of R. A. Weston, Norwich.

Nov. 6.—Joint Consultative Committee (Domestic Development Committee and S.B.G.I.). Gas Industry House, 2.30 p.m.

Nov. 8.—Institution of Chemical Engineers: "Modern Tar Distillation Plants," A. L. Curtis. College of Technology, Manchester, 3 p.m.

Nov. 11.—Institution of Chemical Engineers: "The Purification of Gases in Low Temperature Processes," T. A. Hall and G. G. Haselden. Apartments of the Geological Society, Burlington House, 5.30 p.m.

Nov. 12.—Scottish Junior Gas Association (Eastern District): Visit to the Gothic Works of Messrs. R. & A. Main, Ltd., Falkirk.

Nov. 12.—Manchester District Junior Association of Gas Engineers: Visit to the Chesterfield works of the Bryan Donkin Company.

Nov. 12.—B.G.C. Domestic Development Committee, Gas Industry House, 2.30 p.m.

Nov. 21.—London and Southern Junior Gas Association: Meeting, Gas Industry House. Paper by Dr. E. Spivey on "Cooling Operations as Applied to Gas-works Processes."

Letters to the Editor

Carbonization in Horizontal Retorts

DEAR SIR,—I am very grateful to Mr. Toogood for his courteous letter. May your readers forgive me my lack of clarity on the grounds that I tried to keep the Paper, " Carbonization in Horizontal Retorts " (" JOURNAL " of Sept. 10) short as needs be in these times.

For argument's sake, let us consider a column of hydrogen totally enclosed and 1 sq. ft. in section containing 1 lb. molecule of the substance, approximately 2 lb. in weight, and therefore 359 ft. high at standard temperature and pressure. Because the gas is compressed by its own weight of 2 lb. it will be denser at the bottom than at the top, so we must be careful in our application of the term " standard pressure " since the pressure will decrease all the way up and can have standard value at only one level in the column, and this will be the mean level. Because there is a greater quantity of gas in the bottom of the column than the top, this mean level, which is the gravimetric mean, must be at a slightly lower altitude than the geometric mean. The pressure at the gravimetric mean level will be one atmosphere of 14.7 lb. per sq. in. or 14.7 by 144 lb. per sq. ft. = 2,100 lb. per sq. ft. (approx.). But the 2 lb. per sq. ft. of pressure exerted downwards by the gas will increase the pressure in the bottom of the column to 2,101 lb. per sq. ft. and decrease the pressure in the top to 2,099 lb. per sq. ft. These pressure differences are very small indeed, and because they are Absolute pressure differences can only be revealed by the use of a gas barometer and not by the use of an ordinary atmospheric type of gauge.

Now let us examine the case of a similar column of nitrogen, which is close enough in density to air for the purpose of our argument. One pound-molecule of nitrogen weighs 28 lb. approximately. So in this case the pressure of the gas will be 2,114 lb. per sq. ft. at the bottom of the column and 2,086 lb. per sq. ft. at the top. Thus the relative pressure of the hydrogen is 13 lb. per sq. ft. less than the nitrogen at ground level and 13 lb. per sq. ft. more than the nitrogen at 359 ft. above the ground—a curious and contradictory result which shows that both Mr. Toogood and myself can be right according to the terms in which we speak. The comparative pressures and not the Absolute pressures are, however, the ones which we usually measure when using ordinary atmospheric gauges on our works, and here lies the explanation of the greater pressures we measure at the top of gasholders and ascension pipes as compared with their bottoms.

These conditions are never reversed in gasholders, but may appear to be in working ascension pipes when they are semi-blocked or too small.

The lift or buoyancy of 359 cu.ft. of hydrogen in nitrogen is the difference between the pound-molecular weights of the two substances —namely, 26 lb. If helium of pound-molecular weight 4 (double the density of hydrogen) is substituted, the lift is 24 lb.—not a very different figure—so the lift is by no means directly proportional to the density of the lifting gas. Thus, after a point, it matters little whether the lifting agent is helium, hydrogen, or very hot air or steam, but the fact stands out that in a scrubber standpipe column the calculated or measured pressure inside the top mouth-pieces as compared with the outside air is greater than the corresponding pressure inside the bottom mouth-pieces. Only these pressures concern us in our practice because they can be the cause of leakage.

It would certainly be better to use descension pipes than ascension pipes, not on account of these small pressure differences, whichever way round we like to think of them, but simply because liquids insist on running downhill. We have not adopted descension pipes because we want offtakes at both ends of the retorts but do not know how to fit descension pipes in on the side of the setting where the fleuve and producers are situated.

One final point of interest. When ventilation air is pumped down mines it gets warmer, due to auto-compression by its own weight. This is usually the greatest single factor which causes deep mines to be unbearably hot and so, paradoxically, the more air which is forced down the pit, the hotter it tends to become. Energy is required to release this heat and so it actually requires more power to make air go downhill than uphill and here, because we are comparing air pressures with air pressures, we are only concerned with Absolute pressure values. Were we trying to force hydrogen down the pit into an atmosphere of air, more power still would be required because we should then be coping with both Absolute and relative pressure increases and power would be needed just as when a balloon is hauled down by its winch, but if the atmosphere were hydrogen, less power would be needed than with air because of the less auto-compression of hydrogen. So I think that " natural buoyancy " is not, after all, such a very wicked term when we are comparing gas with air as we are when considering the tendency of gas to leak from mouth-pieces into the air. These considerations only apply seriously to considerable changes in altitude and are purely academic in a retort house collecting main system, though they are important on hilly districts and very important indeed when designing stacks or gasholders.

In answer to Mr. Toogood's final paragraph, we prefer to keep our gauge point, or its equivalent, low down on the scrubber standpipes so as to ensure that the relative pressure in the lowest mouth-piece is always just above level gauge, and thus prevent air from being drawn up the bottom offtakes when the door is open.

Yours faithfully,

LESLIE MUIR WILSON,
Chief Works Chemist.

Chemical Department,
South Metropolitan Gas Company,
709, Old Kent Road, S.E.15.

Oct. 11, 1947.

Chemists and Technologists

DEAR SIR,—" Combustion Engineer " in his letter to you published in your issue of Oct. 8, pointing out the omission in your Editorial of Sept. 10 of any mention of physics as a necessary study to a budding fuel technologist, voices an opinion strongly endorsed by me.

I am in agreement too with his remark that the science (or to be more accurate the study of it) is neglected as is evinced by even a glance at the class roll of any technical schoôl. I would even go so far as to say that a study of heat is vitally essential to the fuel technology student; how else does he hope to gain a knowledge of, for instance, expansion of gases, calorimetry or latent heat—to mention only three broad headings ?

The physical experiments connected with the study of heat are not exactly exciting and could quite easily be termed dull, but the laws proved and found inflexible form the students' bedrock. I have been thankful on many occasions that some of the truths absorbed years ago " stuck " and regretful too that many more did not, necessitating as it does in my riper and wiser years recourse to the old text-books. To any student of fuel technology I would, therefore, unhesitatingly say that the findings of Black, Newton, Dr. Cullen, and a host of others, handed down through two centuries and found unshakeable, are vitally essential.

Yours faithfully,

J. TAYLOR.

Cowper Penfold & Co., Ltd.,
Richmond, Surrey.

Oct. 15, 1947.

The World Power Conference

DEAR SIR,—Your issue of Oct. 8 contained a paragraph by " Abaris " about the Fuel Economy Conference of the World Power Conference, held at The Hague from Sept. 2-10.

Part of "Abaris's " remarks were appreciative, but I do feel impelled to take exception to two of his observations. " Abaris " writes that:

> " Scarcely a word came out of The Hague for the edification of the masses; yet much that went on has a direct bearing on the lives of all of us. . . ."

Both the Netherlands National Committee and the British National Committee did what they could to ensure that the proceedings at The Hague should receive the widest possible publicity in the lay Press. That our efforts were not entirely unsuccessful is shown by the mass of Press cuttings which we have received, but it must be admitted that the space limitations imposed by paper shortage did restrict the amount of publicity which we received in the British lay Press.

" Abaris " expresses the hope that steps will be taken to ensure that Papers of interest to the Gas Industry are " circularized." We are not quite certain what he means by this. The British National Committee received from the Netherlands National Committee an allocation of 34 sets of pre-prints, for distribution for review to the technical and lay Press in this country. These pre-prints were distributed to the best advantage, and the " GAS JOURNAL " received copies of all such Papers as were thought likely to be of especial interest to your readers. The amount of paper allocated to us for printing these pre-prints has not made it possible for us to place them on general sale to the public. But all the Papers presented at the Fuel Economy Conference will be published in the bound " Transactions of the Fuel Economy Conference," to be published next spring. These Transactions will also include a report of the discussions.

Yours faithfully,

C. H. GRAY,
Secretary,
International Executive Council.

World Power Conference,
201-2, Grand Buildings,
Trafalgar Square,
London, W.C.2.

Oct. 15, 1947.

News in Brief

Rawtenstall's 11 p.m. black-out is to be relaxed. The Town Council has approved a scheme of lighting alternate street lamps on main roads between 11 p.m. and midnight.

The Cockermouth U.D.C. has decided to ask the Minister of Fuel and Power for permission to sanction improvements to the retort house and the erection of a new gasholder together with a new automatic controlled district governor.

Newcastle-on-Tyne and Gateshead Gas Company is in touch with Wallsend Town Council regarding the use of land near the Company's existing works at Howden, for purposes connected with the production and storage of gas. The County Planning Officer and the Ministry of Fuel and Power are being consulted.

A Correction. We regret an error in the publication of Part 2 of Mr. B. R. Parkinson's Paper on "The History and Recent Development of the Wet Gas Meter" in last week's "JOURNAL," pp. 155 and 156. The diagrams showing the construction of a meter drum, Figs. 9 and 13, were unfortunately transposed.

The Autumn Meeting of the Eastern Association of Gas Engineers and Managers will be held at the Waldorf Hotel, Aldwych, London, on Thursday, Nov. 6, at 1.45 p.m., under the Presidency of Mr. R. A. Weston, who will give his Presidential Address. The meeting will be preceded by a luncheon at 12 noon for 12.15 p.m.

A Threat to industrial and domestic gas supplies in Accrington, Burnley, Haslingden, Rishton, and Great Harwood was lifted on Oct. 13 by the decision of 300 process workers at Altham coke plant, temporarily to withhold strike notices due to have expired on Oct. 18. The notices were handed in as a protest against what the men regarded as slow progress in negotiations.

Stafford Town Council have approved a recommendation by the Gas Committee that immediate application be made to the Ministry of Fuel and Power for permission to increase the price of gas to all consumers by 3d. per 1,000 cu.ft. Presenting this recommendation, Alderman G. Owen (Chairman of the Gas Committee) said coal costs had increased by 4s. per ton, which would mean an additional cost to the Department of approximately £12,000 a year.

An Extraordinary General Meeting of the Proprietors of the Tunbridge Wells Gas Company will be held on Oct. 29, at Gas Industry House, 1, Grosvenor Place, S.W.1, at 10.30 a.m., for the purpose of considering the raising of money to an amount not exceeding £109,872 by the creation and issue of Preference stock, and the raising by borrowing on mortgage of the Undertaking of the Company or by the creation and issue of Debenture stock or partly by one of these modes and partly by the other of them of money not exceeding the aggregate of (i) £21,907 in respect of the capital of the Company already issued and (ii) such further amounts as the Company are by virtue of Section 2 of the Gas Undertakings Act, 1929, authorized to raise in respect of so much of the Preference stock referred to in the foregoing as may from time to time be issued.

Scottish Industrial Concerns believe that a more rigorous control over river pollution will follow from the publication of the report of the Committee on Estimates, in which reference was made to river pollution in Scotland. Evidence given showed that there was no adequate preventive control in Scotland as in England against river pollution, and that industrial concerns, including paper-works, gas-works, chemical works, and other concerns were using rivers as the most economic method of disposal of trade effluent. There is little doubt but that a much more critical attitude is developing among local authorities, and that trade firms will no longer be pardoned for indiscriminate disposal of refuse into rivers or sea areas. Already certain areas are making such moves, with the angling interests well to the fore. They are demanding that greater powers be given local authorities to force adequate purification of trade liquors at the industrial plants concerned.

The Most Important decision of the International Executive Council of the World Power Conference, at its recent meeting at The Hague, was the unanimous acceptance of an invitation from the British National Committee for the Fourth Plenary World Power Conference to be held in London in 1950. In the regrettable absence, owing to an indisposition, of Sir Harold Hartley, this invitation was conveyed to the Council by Mr. Harold Hobson, in his capacity as Vice-Chairman of the British National Committee. Mr. Hobson was able to inform the Council that the British Government had promised their full support. M. Ernest Mercier (France), who was in the Chair in the absence of Sir Harold Hartley, said how appropriate it was that the first Plenary Meeting of the World Power Conference to be held after the 1939-45 war should take place in London, seeing that the foundation of the World Power Conference was due to British initiative, and that the First World Power Conference was held in London after the first world war, in 1924.

Inauguration of a new purifying installation at Johnstone Gas-works, which was held up for some time owing to severe weather and the fuel crisis, will double the purifying capacity of the works.

The Regional Gas Officer of the Ministry of Fuel and Power is to carry out an investigation into the Campbeltown Town Council Gas-works. This decision follows the disclosure by the Gas Convener, Bailie Colin Campbell, at a Town Council meeting on Oct. 14, that the present annual loss of gas amounts to 10,013,200 cu.ft., equivalent to 15.82%.

The Chesterfield Town Clerk (Mr. R. Clegg) has reported to the Gas Committee upon negotiations with the N.C.B. and the Ministry of Fuel and Power on measures to increase supplies for Chesterfield He stated that no decision had been taken by the Government Departments concerned to implement any alternative schemes for increasing supplies. The Town Clerk was instructed to write the local M.P. (Mr. G. Benson), giving full particulars of the position and requesting, in view of the urgency of the matter, he should raise the matter with the Ministry of Fuel and Power. The Committee is to apply for sanction to borrow £5,137 for the purchase of compressors, gas main and meters, and removal and re-erection of compressing plant at Clay Cross.

Ascot Gas Water Heaters, Ltd., have been actively promoting export sales since the end of the war. The latest Government export drive therefore to them means intensified effort rather than a new activity. Ascots now have agents operating in every part of the world except the Slavic countries. Executives of the company have already flown over 150,000 miles this year in the cause of export trade and have secured business in the teeth of keen competition from local manufacturers. Ascot's Export Manager, Mr. G. H. Rosam, who recently visited the Near East in the company of Mr. Mandy, Ascot's Bristol Branch Manager, will be leaving for a trip to Canada, the U.S.A., and Mexico on Oct. 29, accompanied by Mr. J. A. Franklin, Ascot's Service Manager.

Eighteen Gas Engineers have just concluded a successful year of informal meetings held in Aberdeen each month. The Circle reviews the immediate difficulties and problems which affect their various undertakings, the largest of which is represented in Aberdeen and the smallest undertaking in Banchory. The informal talks on coal, wage agreements, temporary housing, Ministry of Fuel and Power directions, material shortages, &c., have been of great benefit to the members and have created lively discussion. At the last meeting, the Chairman, A. W. Farquhar (Fraserburgh), congratulated Mr. H. A. Milne (Aberdeen) on his election to the Presidential Chair of the North British Association of Gas Managers, and Mr. John Scobie (Stonehaven) on his election to the Council of the same Association.

Mr. James M. Dow, Gas Manager, has reported to the Paisley Town Council that with the advance in coal and freight charges he estimated this would increase the coal bill of the Department by £10,400 a year. Taking into account the estimated additional revenue from the advance of 6s. per ton in the price of coke, there would have to be found an additional sum of £6,000 to meet this year's coal bill. He pointed out that, without an advance in the price of gas, this in effect would increase the current year's estimated deficit to £11,890. To eliminate this deficit during the current year would necessitate increasing the price of gas over the last two quarters by 5.336d. per 1,000 cu.ft., or 1¼d. per therm. On the other hand, if it is desired only to neutralize the additional net cost of coal, the current price of gas would require to be advanced over a like period by 2.693d. per 1,000 cu.ft., or 0.634d. per therm. The Council agreed to recommend that authority be sought immediately from the Ministry of Fuel and Power to increase the price of gas by 1½d. per therm, but as from Nov. 15 next to limit the advance in gas prices to 2½d. per 1,000 cu.ft., or 0.588d. per therm. Basic prices from Nov. 15 will therefore be 3s. 9d. per 1,000 cu.ft., or 10.588d. per therm.

S.B.G.I. GOLF CIRCLE

The Autumn Meeting of the Circle was held at the Richmond Golf Club, Sudbrook Park, on Oct. 8, when members played a Bogey Competition for the Yates Bowl, the winner being Mr. F. D. Drake with a return of 2 down. Mr. J. Hunter Rioch, who was present as a guest, made the best return of all square.

The afternoon Greensome Competition was won by Messrs. J. Simpson and Hunter Rioch with a score of 70—9: 61.

At the Annual General Meeting which was held during the day, Mr. F. B. Holmes was elected Captain in succession to Mr. W. H. G. Roach. Tributes for his long service as Hon. Secretary were paid to Mr. W. R. Edgar on his retirement, his successor being Mr. W. Morland Fox.

COVENTRY BROADENS ITS SERVICE

Apart from the manufacture and sale of gas and its by-products, an important industrial section is being steadily developed by Coventry Corporation Gas Department. Ample evidence to justify their policy was seen by members of the Gas Committee when they paid their annual visit to the Undertaking's various centres last Thursday.

This section makes provision for various industrial services—including the supply of any type of industrial apparatus consumers require for their own use—catering, and space heating. The most important branch has become, however, the heat treatment shops. They were originally set up at Kenilworth Gas-works, which are owned by Coventry Corporation, in 1940 to help manufacturers to to meet war demands. The growth has continued steadily since the war and heat treatment of every kind required by the engineering industry is now done for over 130 local firms.

To offer more convenience to local manufacturers and to give more space and better layout facilities, the shops are now being transferred to the Gas Street depot near the city centre.

Members of the Committee, as the result of what they saw, were undoubtedly more than ever convinced of the increasing potentialities of the industrial section of the Undertaking.

During the tour, it was pointed out that the Undertaking may expect to play a big part in the Midland area under whatever scheme of reorganization of the Gas Industry is undertaken. Some indication of this is given by the arrangements to provide a total of 900 million cu.ft. of gas per year from early next year to Birmingham, Rugby, and Nuneaton, and to install plant, at a cost of more than £1,000,000, by the end of 1951 to enable the anticipated increased demand then expected to be met.

There are hopes that the policy of small profits and a big turnover, which last year produced a record profit of £89,000, may enable the undertaking to face an increased coal cost of £70,000 per annum without raising charges to the consumer.

DISTRICT HEATING

The Court of Common Council of the City Corporation of London at a meeting last week referred to a committee for detailed examination a report by Mr. S. B. Donkin on district heating for the reconstructed City. The report describes a scheme by which hot water and heat would he " laid on " as cold water is now.

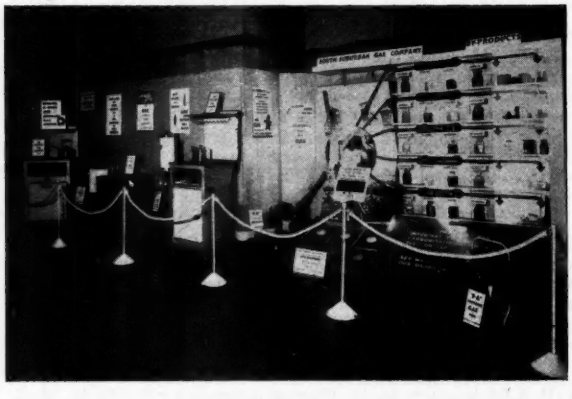
Mr. C. Ernest Link, Chairman of the Improvements and Town Planning Committee, said that the idea had the backing of the consultants, Professor W. G. Holford and Dr. C. H. Holden.

Sir George Elliston, Chairman of the Public Health Committee, at whose instance the report was obtained, said there would be a saving of 100,000 tons of coal a year.

Major S. E. Sandle said he hoped that the scheme would be examined carefully with a view to discovering whether performance would be equal to promise, especially from the standpoint of cost. He understood that the estimate of cost had been based on the assumption that exhaust steam at electricity generating stations could be put to more profitable use; but exhaust steam was already used for heating the intake water to nearly boiling point before it went to the boilers. If that was so he failed to see how the scheme could save the coal indicated.

Mr. W. H. Gunton asked whether there would be compulsion to take the service.

Mr. Link replied that, so far as he knew, there would be no compulsion.



Our photograph is of the South Suburban Gas Company's Stand at the " Home and Family " Exhibition, Erith, referred to in the " JOURNAL " last week

INSULATION OF HOUSES

The officially recommended standards for the thermal insulation of houses represent a big advance over standard practice before the war, and their universal adoption would mean a great improvement in comfort and a big contribution to the conservation of fuel supplies. The attainment of these new standards in all new housing is entirely practicable. Insulation to modern standards is neither difficult nor expensive, and the aggregate supply of insulating materials has been shown by a census of production taken by the Structural Insulation Association among its members to be more than adequate for the largest number of houses which can possibly be built in this country for some time to come, while output of many types of insulating materials could be increased rapidly.

To show how simply and easily the new standards can be reached, as well as the wide variety of suitable insulating materials available, the Structural Insulation Association has prepared a list of representative constructions which reach the new standards. To make it of practical value, the list is confined to traditional house construction as at present designed by local architects and built by local builders throughout the country. Non-traditional types of house construction abound, but their inclusion would make the list unwieldy, and, furthermore, all such constructions are normally subjected to some form of special scrutiny which ensures that their designs reach a proper thermal standard before official approval is given to their development and erection.

The current official recommendation is that the thermal transmittance of roofs, walls and floors shall not exceed $U = 0.20$. This means that the heat lost through one square foot of structure shall not exceed 0.2 B.Th.U. when the difference between the air inside and the air outside the building is 1° F. Better standards should be adopted where economically possible, especially where the use of controllable heating apparatus (as distinct from open fires) permits full advantage to be secured in fuel saving. The list shows certain constructions widely used before the war, and it is seen how far they fall short of current standards and how easily they may be made to conform.

ECONOMY WITHOUT AUSTERITY

Friedman-Athill, Ltd., have introduced two attractive aids to domestic comfort, especially designed to help the dweller in a tiny house or flat, or the unfortunate victim of the housing shortage who may be forced to live in a single room.

Expense is often a deterrent to the installation of a water heater; at the same time boiling water first thing in the morning is desirable. To meet this problem, Friedman-Athill have manufactured the Trickle Heater. This simple appliance consists of a standard high-efficiency six pint kettle heated by a tiny " neat " gas flame in a specially-designed portable holder which can be connected to any gas point. The kettle can be filled at night and for the cost of a farthing, as the tiny jet consumes less than 1 cu.ft. of gas per hour, there will be three-quarters of a gallon of very hot water waiting for use in the morning, enough for the morning cup of tea, and, with the addition of cold water, for toilet purposes and washing-up. By adopting the same procedure after breakfast, there can be an equal supply ready on return from work in the evening.

Another innovation manufactured by this firm is the " MIJ " portable heater, which is a small fire for the bed-sitting room, kitchen, bathroom, and, in fact, every room in which a little heat is needed at short notice.

This is of similar design to the " Fa-neat " gas portable fire FA/3, but is really a tiny edition of this, with the unbreakable heat-resisting steel radiant with three neat gas jets and reflector, which give a high efficiency and a pleasant appearance. The cost of running amounts to approximately ½d. per hour.

Other " Fa-neat " gas appliances displayed as being of particular advantage to the single-room dweller were single and multiple burner rings, portable fires of the larger type FA/3, gas towel rails FA/5, and a gas hotmeal cabinet in which insulation makes it possible for food to be kept at a low temperature ready for serving. These appliances justify Friedman-Athill's slogan " Economy without austerity."

In July the Watford and St. Albans Gas Company's Golf Team defeated a team from Ascot Gas Water Heaters, Ltd., at Harewood Downs Course. On Oct. 11, a return match was played at Hammers End, Harpenden, and again the Watford and St. Albans Gas Company's team were the victors by 4½—½. The final scores were as follows: R. F. Robinson and W. J. Chesters halved with J. A. Franklin and N. Barnes; H. C. Dunbar and S. Briggs beat N. Pleasance and A. Mackie—2 and 1; C. Parsons and F. Roberts beat C. Force and W. Bell—4 and 3; A. Baldwin and C. Dolamore beat R. W. Byford and C. Wigham—4 and 3; F. Brookes and F. Doult beat L. Upsdell and A. Dryer—7 and 6.

NEW CARBONIZING PLANT AT LYDNEY

HISTORY was made recently at Lydney, Glos., affecting not only the inhabitants of the town and of the surrounding country, but the Gas Industry as a whole. A system of integration of gas manufacture and supply of the greatest importance to the industrial development of the area is to be put into operation, the project encouraged by the sudden growth of new factories within a small radius of Lydney. The scheme was officially launched on Oct. 9 when, at the invitation of Mr. C. H. Chester, Chairman of the Lydney Gas Company, some 50 guests inspected the new installation. The visitors, who included a number of gas engineers, members of the local Council, and representatives of some of the factories to benefit by the new scheme of development, were conducted round the works in parties and were able to examine the new plant in operation.

The New Plant

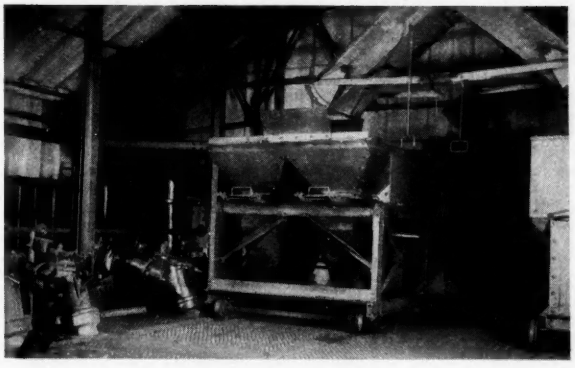
The contract for the carbonizing plant was placed with W. J. Jenkins & Co., Ltd., of Retford, and their system of intermittent vertical chambers was selected because of the high output obtainable from a limited ground space and the ability of this type of plant to carbonize Forest of Dean coals of all descriptions with the production of high grade coke suitable for industrial and domestic use.

The carbonizing plants at Lydney and Coleford consisted of small horizontal retorts, each holding about 3 cwt. of coal, which were charged with a shovel and the residual coke manually extracted by a rake. In the new plant all arduous manual work is eliminated and the plant, although on a small scale compared with many installations, is nevertheless fully mechanized and equipped with up-to-date controls.

In view of the speed with which the original works at Lydney and Coleford were completed 100 years ago, it is interesting to record that the contract was placed with W. J. Jenkins & Co., Ltd., in October, 1945, Ministry of Fuel and Power sanction granted in December of that year, foundation work started in May, 1946, and gasmaking commenced in January, 1947.

The new installation consists of one bench of ovens in three independent settings of two chambers. Each setting is equipped with a built-in step grate producer and recuperators. The plant is capable of producing 220,000 cu.ft. of 450 B.Th.U. quality gas in 24 hours. The installation is housed in a steel-framed structure covered with corrugated asbestos sheets and occupies a site formerly used as a coke yard. The layout has been planned with a view to 100% increase in the size of plant.

Coal is charged at ground level into the skip of an electrically-operated skip hoist, which elevates it automatically and discharges direct into the chamber charging car. There are no overhead storage bunkers, but provision has been made in the design for later addition of these, when the bench is extended to a size justifying overhead storage and labour economy. The same skip hoist elevates coke for the producers and breeze for the chamber breeze pads.



Top bench and charging car

The chambers are constructed of 95% Consett silica and are approximately 12 ft. high by 6 ft. 6 in. wide on the major axis, with a uniform taper to 11 in. on the minor axis. The chamber heating flues are formed by continuous tongued and grooved key tiles bonding adjacent chambers throughout the full width, thus forming an entirely monolithic construction which gives maximum strength to the oven walls to enable them to withstand the pressures exerted by strongly swelling coals. Expansion space for the silica material of the ovens is provided on the periphery of the silica work, thus avoiding any possibility of distortion of the oven and ensuring long working life.

The chambers each have a nominal capacity of 1.4 tons of coal and are designed for a carbonizing period of about 16 hours when producing gas of 450 B.Th.U. quality.

Charging of chambers is carried out at regular intervals and flexibility of the plant is such that (dependent on gas production requirements) the charging period may be varied from 16 to 24 hours. The hand-propelled chamber charging bus is compartmented for coal and breeze, and is designed so that easy adjustment can be made on either material. A noteworthy feature is the interlocking of the discharge operating levers which make it impossible for the stoker to charge coal before the protective breeze pad (necessary for the protection of the bottom doors and to bring the coal into the heating zone) is released.

Gas from the chambers is aspirated by means of offtakes at both top and bottom of each chamber. The bottom gas offtake is of a patented type, use being made of the bottom discharge door for this purpose. The offtake is actually formed in the dome of the chamber door, which is virtually a semi-circular pipe with a number of gas inlets throughout the full length of the dome and through which gas passes to the collecting mains. This patented offtake is a feature of the Jenkins plant, and by its use pressure in the lower part of the ovens is entirely eliminated, allowing the use of water-sealed discharge doors, which have the advantage of providing a positive seal at all times, thus preventing leakage of gas from, and air into, the chambers. A noteworthy feature of the bottom discharge doors is the hand-operated closing gear, which is made possible by counter-balancing of the door.

The gas offtakes, hydraulic mains, valves, and collecting mains are continuously sprayed with hot ammoniacal liquor to prevent any possible accumulation of deposits, thereby ensuring trouble-free working. Two liquor circulating pumps are installed, one a steam-driven "Weir," the other an electrically-driven centrifugal by Bryan Donkin.

After complete carbonization, the coke is discharged into a receiving wagon which is hand propelled, and the coke is conveyed to the quenching chamber, where a predetermined amount of water is sprayed on it from an overhead tank. The steam is conducted from the quenching chamber by means of a timber-lined steel framed offtake. An electrically-driven centrifugal pump is normally used for re-circulation of quenching water.

Of the ancillary plant, the existing wet and dry purification plant has been completely replaced by units suitable for the future output. A vertical boiler by the Cradley Boiler Company, fitted for breeze and coke burning, supplies steam for exhauster, liquor pump, the vertical bench, and the compressor; this unit is to be duplicated this year. A steam-driven exhauster of 12,000 cu.ft. per hour capacity will, this year, be duplicated by a machine of similar size. The new condensers are by Firth Blakely & Company, and are of their air-cooled type, and a new livesey washer was supplied by Messrs. W. C. Holmes & Co., Ltd. The purifier boxes were originally built by Newton Chambers, of Sheffield, for the Air Ministry's hydrogen production, and were dismantled and re-erected by W. J. Jenkins & Company. The gasholder is of 100,000 cu.ft. capacity, two lift spiral guided in an overground steel tank, and was designed and built by Firth Blakely & Company. Two compressors, one steam driven and the other electrically driven, by W. C. Holmes & Co., Ltd., will be installed this year, each of which is of sufficient capacity to supply Coleford and other parts of the development scheme.

"The Spirit of Venture"

Following the inspection of the works, visitors were entertained to lunch at the Feathers Hotel, Lydney, by invitation of the Directors of the Lydney Gas Light and Coke Co., Ltd., and the Coleford Gas and Coke Co., Ltd.

Proposing "The Guests," Mr. **Ralph Williams,** Director of the Lydney Gas Company, described it as a very desirable toast, as nothing so helped human happiness as a meal and a chat; he was delighted that so many had given up their time to come and see their new works. He thought they were indeed fortunate to have such a capable man as Mr. Chester on their Board, for he was a gentlemen possessed not only of great ability but a kindly disposition. He occupied a high position in the Gas Industry and they as "infants in the wilderness" were glad to benefit from his experience.

Briefly relating the history of the Lydney Company, he expressed the regret which he felt sure was shared by all present that Mr. William Jones, J.P., under whose chairmanship the programme of expansion had been decided, had not lived to see his ideas bear fruit. His successor, Mr. Percy Moore, who had done much to mould the scheme, had only survived him by 12 months. He knew how happy these gentlemen would have been could they have been present on such a memorable occasion. The Lydney gas-works first operated on Dec. 28, 1861, and it was amusing to think that the salary of the

first manager was one guinea per week. The works struggled along giving of its best, but by the time he joined the Board it was clear that the old plant was fast becoming obsolete. It was necessary to face up to the development of the Forest of Dean; the net result of their efforts could be seen to-day. At that time many friends said: "Why worry? Nationalization is coming." He felt that attitude was wrong and that it was essential to look beyond that stage; they must at least try to leave their works better than they had found it. If the Industry was to be nationalized, they would hand over a going concern. When the subject of a new works was broached, the Ministry of Fuel and Power had been most helpful. They had decided to spend a good deal of capital and with the sanction of the Ministry, a scheme for a new modern works to supply Coleford was drawn up. The results of their work had been seen that morning. They were honoured to have so many guests from local authorities with them; it was good to know the wide approval of their policy of development.

Replying, Mr. **R. Maynard Bennett,** Chairman of the Royal Forest of Dean Development Association, said that his knowledge of the Gas Industry commenced at perhaps an earlier age than some. His headmaster had also been a scientist and was, in fact, a direct descendant of the inventor of incandescent light, William Murdoch; not surprisingly he had seen to it that his pupils knew something of gas manufacture. He had been struck by Mr. Williams' comments on the present situation; it was, he felt, a period of transition, calling for the spirit of venture and great faith. Since the cessation of hostilities the Dean Forest had made tremendous progress; the Directors of the Lydney Gas Light and Coke Company had done the same. The Lydney works were admirably situated and this, coupled with the very considerable activity all around, should consolidate into something fine. Quoting figures relating to coal stocks in this country to indicate their rapid decline, he stressed the importance of conserving this diminishing wealth. It was essential to be economical; at the same time too much caution was dangerous. Their future work should be based on the proper usage of coal, and with good organization and goodwill, they could stand on the threshold of huge possibilities. War and poverty, the two arch-demons of world progress, must be relegated to their proper place. The world was full of God-given bounty which should be used for the benefit of society; only man's inhumanity to man messed everything up. He felt they had that day at least made a contribution to the future happiness of the Forest. Great credit was due to Mr. Chester, and they considered themselves fortunate to have him as their Chairman. This was an age of specialists and he knew Mr. Chester's sagacity and experience would do much to bring them the prosperity they hoped for.

Mr. **W. Morland Fox,** Director of W. J. Jenkins & Company, said his name had been placed upon the list of speakers with a dual purpose, for not only was it his privilege to propose the toast of the Lydney and Coleford Gas Companies, it was his duty on behalf of his Company to ask the Directors to take over their new plant after the usual six months' maintenance trial. He considered the undertaking a remarkable one and wished to pay tribute to the kindness and co-operation shown to members of his firm by the Lydney officials. He had great admiration for their courageous step for which little or no immediate return was visible. Certainly they could not be remunerated for the thought and energy that had gone into the scheme. He had known the Swindon works before Mr. Chester's arrival and he had watched the improvements carried out there. There was no doubt that Mr. Chester's scheme for gas integration was considered one of the best in the country. He was greatly impressed with the development of the Forest of Dean area and wished all concerned with it and the Lydney and Coleford Gas Companies every success.

In reply, Mr. **C. H. Chester,** O.B.E., described how he first came to Lydney, how his visits became increasingly frequent, and how he was eventually asked to join the Board of the Lydney Gas Company. It was a step he had never regretted. As a Yorkshireman and a realist, he had had a grand opportunity of proving his development blueprint. The progress made in the development of the Forest of Dean convinced him that it was the right thing to do, and they had simply got on with the job. Here he was glad of the opportunity to thank Mr. Oliver, his Engineer at Swindon, who had been a tower of strength in the considerable work attaching to the new venture. The plan was there for development over the next five or 10 years. The annual consumption at the present time was 36 million cu.ft., a far cry from the 200 million which they had in mind. There was need for more capital expenditure and technical work and that, coupled with the increased cost of production, necessitated their looking at the whole thing in its proper perspective. The benefits of increased outputs must be passed on to the consumer. Mr. Chester then quoted figures to show how, since the war, production costs had grown, coal rising from 23s. per ton to £3 9s., labour expenses increasing by 90%, &c., yet the price per therm to the consumer was only 5% higher. He was very happy to accept the responsibilities of the new plant, which he considered an admirable job. It had been designed primarily to treat coal efficiently and to cut out onerous labour. He had that morning taken some of the visitors to see the old plant at the works, which had required attention from morning to night, giving no rest to the workmen. When men were forced to keep their noses to the grindstone in bad conditions, naturally results would be poor. Now the workmen did not work two hours on the shift. He was a firm believer in the saying that a tidy mind was an efficient mind. He was glad, too, to welcome those members of the staff who had served five years with the Company.

He had been struck by Mr. Bennett's reference to coal conservation and its efficient usage in industry in this country. Coal and agriculture were the only real assets of our national wealth. There was no good reason for the smoke which overhung our towns, or for the dustcarts and other vermin producers. It was probable that within the next 10 or 15 years towns would become smokeless; similarly there would be less labour in the home. It was true to say that a happy home background made for a happy England; the Gas Industry had a large contribution to make to the happiness of the housewife. There was, of course, room for electricity, and indeed for everything that made things easier; it was a foolish man who said that his competitor had no right to live. The carbonization process was unique in that it recovered 80% of the original energy in coal, giving gas, coke, and numerous derivatives. As Junior Vice-President of the Institution of Gas Engineers, he had recently had the opportunity of discussing the development of the South Wales distressed areas, where a £5,000,000 plan was being put into operation for the provision of 5,000 million cu.ft. of gas per year, with extra carbonization and mains; in this area one factory would use five times as much gas as Lydney now makes. Gas was a clean fuel at an economical price, and its efficient use with automatic control prevented waste and rejects in industry. If Lydney was to be a progressive area with congenial employment, it was essential to have the right fuel at the right price. They might rest assured that the technicians of the Gas Industry were much alive. The Gas Research Board, which spent a quarter of a million pounds per annum on research into the efficient carbonization of coal, producing apparatus reminiscent of H. G. Wells, might in 10 or 20 years provide something revolutionary; until then they could rest assured they had the best and most efficient plant.

Concluding, he said that W. J. Jenkins & Company were building another big plant at Swindon for which they had high hopes. In this happy atmosphere it was his pleasure to extend their thanks to Mr. Fox, to Mr. M. Haigh who had supervised the installation, to Mr. H. W. Castleton, Engineer and Manager at Lydney, and to all who had contributed to a happy day.

Afternoon Visit

After lunch the guests were conveyed by coach to the Lydney Industrial Estate to inspect the new factories which are being developed there. They were welcomed by Mr. **J. H. Mills,** Managing Director of Lydney Industrial Estates, Ltd., who explained some of the work in progress.

The Company, he said, was incorporated on Mar. 26, 1946, to take over as from Sept. 1, 1945, a lease (with options extending to a total period of 99 years) of the estate at Harbour Road, Lydney, belonging to the Ministry of Supply and previously occupied as a storage depot. The arrangement was sponsored by the Board of Trade and the intention was, as its name indicated, to develop the estate as an industrial estate. The introduction of new industries to the area with the resulting effect on employment and trade generally could not but be to the benefit of the area as a whole. The estate covered an area of approximately 66 acres, and contained 10 large buildings, with a covered floor area of just on 210,000 sq. ft., and 16 smaller ones with a covered floor area of over 46,000 sq. ft. in addition to an office block, canteen, and numerous other buildings. In order to make the buildings, which were originally used for storage purposes only, suitable for use as factories, it has been necessary to provide a central heating system, increased lighting arrangements, additional electricity input for power purposes, and also an increased gas supply to all the buildings. This had, of course, taken a considerable time, especially under the present difficult conditions and had involved a very considerable expenditure, but this work was now practically completed and all the sheds would be properly equipped by the end of the present year. But while all this work had been going on, the estate has not been idle. A Company was formed for the construction of motor omnibus and coach bodies and this has been functioning since Jan. 1, 1946. For the first 18 months, the work consisted mainly of the repair and reconstruction of omnibus bodies, both single deck and double deck, but a start had now been made on the construction of new vehicles and a number of these had already been completed. A No. 2 factory of the Whitecroft Pin Manufacturing Co., Ltd., was also started.

There were at present employed on the estate a total of approximately 225 workpeople of all grades. There had actually been considerably more than this, but owing to the lack of housing accommodation, a number of the skilled men, particularly in the body-building Company, have returned to their homes and this had, in turn, meant an unavoidable reduction of the semi-skilled and unskilled grades. The solution was, of course, houses and this, in fact, was the major problem at the moment. The labour force which it was anticipated would be required when the estate got into full swing was not less than 2,000, and might be considerably more than this.

He concluded by expressing thanks to the Directors of the Lydney Gas Company for allowing them to join in the day's arrangements.

THE FUNCTION OF CONVECTION AND RADIATION IN HEATING BY GAS*

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THE present trend of heating technique in Britain is to increase the proportion of radiant to convected heat for process drying and for the heating of industrial and commercial premises, and to increase the proportion of convected to radiant heat for the heating of domestic premises. These changes have developed through a better understanding of the relative functions of convection and radiation and result in better service with reduced fuel usage.

Developments in the design and utilization of gas-heating appliances have helped to make such changes possible.

Industrial Heating and Drying Processes

General Considerations

The last decade or so has seen the widespread application to industrial heating and drying processes of methods in which most of the heat transfer takes place by radiation, although some convection transfer inevitably occurs since the air becomes heated by contact with the radiating source and the irradiated body. These methods make use of the much greater rates of heat transfer which are obtained under suitable conditions by employing radiant energy.

The mechanism of heat transfer by radiation differs fundamentally from convection, since the rate of radiation transfer is proportional to the difference of the fourth powers of the absolute temperatures of the source and receiver, while that by convection depends either on the temperature difference (forced convection) or on its five-fourths power (natural convection). Thus the rate of radiation transfer for a given temperature difference may greatly exceed that by convection, especially when the source temperature is high. These considerations, and also the influence of the gas velocity in forced convection, are illustrated by the data in Table I, in which the rates of heat transfer to a receiver at 60° F. (15.6° C.) or 250° F. (121.1° C.) are compared for the following conditions:

(*a*) By radiation from sources at 650° F. (343.3° C.) and 1,600° F. (871° C.). These are the respective temperatures at which medium temperature and high temperature gas units are usually operated.

(*b*) By natural convection and by forced convection at different velocities from air at 150° F. (65.5° C.), 250° F. (121.1° C.) and 650° F. (343.3° C.).

(*c*) By radiation from a source at 650° F. (343.3° C.) combined with natural and forced convection from air at 250° F. (121.1° C.).

TABLE I

Method of heating	Rates of heat transfer in B.Th.U./sq.ft./hr.* To object at 60° F.			To object at 250° F.		
By radiation from source at—						
650° F.	2,500			2,190		
1,600° F.	31,000			30,700		
By natural convection; air at—						
150° F.	90			—		
250° F.	230			—		
650° F.	930			570		
	Air velocity (ft./sec.)			Air velocity (ft./sec.)		
	10	30	50	10	30	50
By forced convection; air temperature—						
150° F.	270	630	990	—	—	—
250° F.	570	1,300	2,100	—	—	—
650° F.	1,800	4,100	6,500	1,200	2,800	4,400
By radiation from source at 650° F., combined with natural convection from air at 250° F.	2,700			2,190		
	Air velocity (ft./sec.)			Air velocity (ft./sec.)		
	10	30	50	10	30	50
By radiation from source at 650° F., combined with forced convection from air at 250° F.	3,100	3,800	4,300	2,200	2,200	2,200

* 1. B.Th.U./sq.ft./hr. = 2.7125 kcal./sq.m./hr.

These data broadly indicate how methods of heating, in which the transfer is substantially by radiation, frequently enable much faster heating rates to be realized in practice than would be attained by orthodox convection methods. For this reason the development of "radiant heating" processes naturally received tremendous stimulus during the war years when the rapid and large scale processing of a wide range of articles was the primary consideration. Although as much attention as possible was paid during this period to the cost and efficiency of the processes, these questions had necessarily to be subordinated to the demands for speed of production.

The present position in Great Britain is that, although the need still exists for speedy production of goods in quantity, the paramount necessity is for efficiency and maximum fuel economy of industrial heating processes. The experience already gained with radiation methods has not only shown their advantages, but has also exposed their limitations. It has established that just as radiation transfer may be important in the so-called convection methods, as pointed out by Andrew and Chamberlain,[1] so may convection play a substantial part in radiant heating.

The Functions of Convection and Radiation

In the heat exchange problems presented by industrual heating processes convection and radiation methods of heat transfer have normally separate and distinct functions. An object heated by convection is gradually brought up to the required temperature, and at this stage attains equilibrium with its surroundings. In radiation heating the heat transfer rate is greater, so much so that the object is raised to the requisite temperature long before the equilibrium state is reached. In addition, and particularly for massive articles exposed to high intensity radiation, the surface temperature may rise much more rapidly than that of the interior. Under these conditions paint films on heavy metal articles can be cured before the bulk of the article attains the curing temperature.[2]

Speed of heating and thus speed and quantity of production are, therefore, the primary functions of the radiation component of heat transfer in industrial heating processes. In practice, however, cases often arise where the nature of the material being processed imposes serious limitations and radiation methods then offer little if any advantage over convection. Most industrial materials are opaque to radiation, so that the mechanism of heat transfer consists of surface absorption of the radiant energy, and the interior is heated by conduction from the surface. Under radiant heat, materials of low thermal conductivity may develop high surface temperatures and correspondingly high internal temperature gradients. In such cases, the surface may spoil before the material becomes uniformly heated throughout, and this can only be avoided by reducing the intensity of radiation to such an extent that the subsequent rate of heating may be no greater than would be obtained by convection methods. A typical example of this is shown by tests on bakelite moulding powder preforms, in which radiant heating offered no advantage over convection as regards speed. Similarly, convection is preferable for heating or drying materials liable to crack or burst as a result of excessive temperature or moisture gradients—*e.g.*, large clay and ceramic masses.

One function of convection lies, therefore, in the heat treatment of this class of material with which the advantages of radiant heating cannot be obtained. Examples of such materials the processing of which by radiant heat was not successful are given by R. F. Hayman.[3]

The choice of either convection or radiation methods in any particular case is also a question of practical convenience or necessity. Radiant heating is best suited to continuous production systems, in which the heat treatment forms one stage in a series of interdependent processes. On the other hand, convection methods are usually the obvious choice for the discontinuous heating of the material in separate batches.

Although relatively small, convection plays an important role in radiant heating. The data in Table I indicate how a high ambient air temperature in radiant heating equipment serves to increase the heat transfer rate, especially if forced circulation can be employed. In addition, a high air temperature is desirable to minimize the heat lost by the object receiving radiation once its temperature exceeds that of the surrounding air. The marked influence of air temperature on heat losses by convection, especially from sharply curved objects, and its consequent bearing on the performance of radiant heating appliances have been emphasized recently by J. B. Carne.[4]

One limitation in radiant heating practice is the need to have all the surfaces of the object exposed to radiation. This drawback is not so serious with sheet metal articles, the high thermal conductivity of which tends to secure uniformity of temperature, but with materials of low thermal conductivity the temperature of surfaces screened from direct radiation may lag seriously behind that of freely exposed surfaces. In such cases convection may serve a further purpose in raising the temperature of the shadowed portions to the general level.

The combination of some measure of convection with radiant heating may thus not only offset some of the disadvantages of radiation heating, but may also enable the process to be operated at a greater speed and with greater economy. In the domestic field also, the choice of the optimum proportions of radiated and convected heat for space heating assumes considerable importance, particularly in regard to the way in which maximum comfort can be attained with the lowest possible

* Paper submitted at the Fuel Economy Conference of the World Power Conference, The Hague, 1947 (and British National Committee).

expenditure of fuel. This question is discussed in detail later in the Paper.

The wide variety of industrial heating processes in which gas radiant heat equipment has been used has recently been described by R. F. Hayman.[3] The present trend to use more convection in combination with radiation offers encouraging prospects for further economy, especially if the products of combustion from these appliances can be used directly or indirectly to augment the convection component.

The Characteristics of Gas-fired Appliances for Radiant Heating

Radiant heating by gas is carried out by two principal types of appliances:

(*a*) Medium temperature units, in which the radiating surfaces are mild steel black panels forming the front face of a combustion chamber, the back of which is insulated.

The panels are heated from behind by products of combustion from non-aerated burners, and usually operate at temperatures from 450° F. (232.2° C.) to 650° F. (343.3° C.).

The units which can be joined together to give a tunnel of any desired length, are usually built in semi-cylindrical sections, 3 or 4 ft. long and 2, 3, or 4 ft. (0.61, 0.91, or 1.22 m.) in diameter. Single flat panels, horizontal or vertical, or box shape tunnels are also available. In another type, the radiating surfaces consist of a number of parallel metal tubes, each of which is heated internally by gas burners at one end, the products being exhausted from the opposite end. With panel temperatures of 650° F., the total intensity of radiation on the stock being treated is about 4,000 B.Th.U./sq.ft./hr. (10,800 kcal./sq.m./hr.).

Uniformity of radiation intensity is a particular feature of these units, temperature measurements on the radiating face of a 3 ft. section of a tunnel showed 645° F. (340° C.) in the upper, 650° F. (343° C.) in the lower zone, and 683° F. (363° C.) in the middle.

(*b*) High temperature units consisting, in effect, of two incandescent refractory surfaces facing each other.

One type of panel consists of vertical refractory rods spaced in front of a refractory back and heated by the products of combustion from non-aerated burners. The total intensity of radiation from these units is about 50,000 B.Th.U./sq.ft./hr. (135,000 kcal./sq.m./hr.) at an operating temperature of 1,600° F. (871° C.).

The Emission Spectra from Radiating Sources

The emission spectrum has been calculated for a medium temperature black panel emitter at 650° F. (343.3° C.), and determined for a high temperature unit at 1,600° F. (871° C.). The former shows a maximum intensity at about 5μ, and the proportion of radiant energy emitted at longer wavelengths is substantial. The emission from the high temperature unit shows characteristic absorption and emission bands of H_2O and CO_2 and the maximum intensity of radiation occurs at lower wavelengths, as would be expected. Most of the radiation, however, lies between about 2μ and 6μ.

In radiant heating practice, both the wavelength distribution of the radiation from the source and also the absorption and reflection characteristics of the irradiated object are of considerable significance. For example, the spectral reflectivity (*i.e.*, the reflectivity at any given wavelength) of paint pigments normally decreases with increasing wavelength, so that for radiation of wavelengths above about 5μ the reflectivity of a wide range of pigments is small and largely independent of the pigment colour. Thus, in practice, when using medium temperature sources the effect of colour on the drying time of paints is negligible, but with very high temperature sources giving essentially short wavelength radiation (*e.g.*, electric lamps in particular) colour effects are often marked, and wide variations in the stoving time of differently coloured paints may be encountered.

The capacity of the material to absorb radiation may also be selective in that the absorption may be pronounced at particular wavelengths. Measurements of the transmission and absorption of infra-red radiation by typical paint films have shown the presence of selective absorption bands at 3.2, 4.5, and 6μ, and that the absorption of incident radiation was complete for wavelengths above about 7μ.

Similarly, the heating of transparent plastics by radiation is performed more quickly by employing long-wave radiation, since materials of this type are much more transparent to short-wave (*e.g.*, 1μ to 2μ) than to longer wave (*e.g.*, above 3μ) radiation. The conclusion reached from a general survey of the characteristics of a wide range of industrial materials which are processed by radiant heating methods was that in general it was preferable to employ sources emitting long-wave radiation to secure the best performance.

Lines of Future Development and Research

The experience now gained has established the wide applications of radiant heating. The effect of the absorption and reflection properties of many industrial materials on the mechanism of radiation transfer is well understood, but new problems are bound to arise as the range of application is extended. It is considered that furture developments should include new or further investigation of the following:

(*a*) The absorption and reflection properties of industrial materials to establish the wavelength range of the radiation which should be used to obtain the maximum speed and economy of process heating.

(*b*) The reflection characteristics of polished metals and other materials which may be used as reflectors in gas-heated appliances.

(*c*) The emissivity of refractory materials at high temperatures, with special reference to its influence both on the overall emission and also the radiant efficiency of high temperature units employing gas-heated incandescent surfaces.

(*d*) The use of hot air circulation in combination with radiant heating.

Space Heating—Domestic and Industrial

Comfort Heating

The function of convection heating alone is to raise directly the air temperature in a room so that the heat losses of an occupant are at the desirable level to give a feeling of warmth. Generally speaking, the temperature conditions will be uniform and the environment will be at a lower temperature than the air. The function of radiant heating alone is to heat the occupant directly, so that suitable heat losses are maintained at a lower air temperature, and indirectly to raise the air temperature. In general, the temperature conditions will not be uniform and the environment will be at a higher temperature than the air.

Before considering the practical application of radiant and convected heating it is desirable to define comfort standards. It is important to distinguish between " warmth comfort " which defines the conditions under which an occupant is neither too hot nor too cold and " degree of comfort " which compares the " pleasantness " obtained under the same conditions of " warmth comfort." Two levels of comfort also need consideration; " minimum comfort " when an occupant would regard conditions as tolerable and " full comfort " when conditions are ideal.

The conditions of warmth comfort are well understood for convection heating and are generally accepted in Britain as 65° to 68° F. (18.3° to 20° C) equivalent temperature for " full comfort " in a living-room. The conditions for " minimum comfort " are less certain but are generally accepted as 59° to 62° F. (15° to 16.7° C.). A temperature of 45° to 50° F. (7.2° to 10° C.) is reasonable in parts of a house where the occupant is not normally sedentary.

The conditions of warmth comfort are not well established for radiant heating by undirectional sources, as the Eupatheoscope is unreliable under such conditions. K. W. Yarnold[5] designed a Double Eupatheoscope and measured separately the " front " and " back " equivalent temperatures of occupants in a room heated by a fire. Tests for the Gas Light and Coke Company established the following conditions for comfort. For " minimum comfort " the back equivalent temperature must not be below 56° F., and then the front equivalent temperature should be 68° F. equivalent to a horizontal radiant intensity on the front of 50 B.Th.U./sq.ft./hr.; at 60° F. back equivalent temperature it is not essential to have extra radiant heat; for each 1° F. below 60° F. back equivalent temperature it is necessary to increase the front equivalent temperature by 2° F., equivalent to a horizontal radiant intensity of 14.5 B.Th.U./sq.ft./hr. (39.4 kcal./sq.m./hr.).

The conditions for " full comfort " are less definite as occupants varied widely in the amount of radiant heat they desired, but a back equivalent temperature of at least 60° F. (15.6° C.) is needed. At a back equivalent temperature of 60° F., a front equivalent temperature of 70° F. (21.1° C.), or even higher, was regarded as extremely pleasant although such a high temperature was not strictly necessary. Reasonable figures for the front horizontal component appear to be about 75 B.Th.U./sq.ft./hr. (203 kcal./sq.m./hr.) at 60° F. (15.6° C.) back equivalent temperature, or 60 B.Th.U./sq.ft./hr. (162.5 kcal./sq.m./hr.) at 65° F (18.3°C.) back equivalent temperature. It should be noted, however, that the Department of Scientific and Industrial Research quotes 40 B.Th.U./sq.ft./hr. (108 kcal./sq.m./hr.) as the desirable radiant intensity to give comfort at an air temperature of 58° to 62° F. (14.4° to 16.7° C.), and values as low as 20 B.Th.U./sq.ft./hr.) (54 kcal./ sq.m./hr.) are adequate under certain " minimum " comfort conditions.

The factors which are generally accepted as giving ideal comfort conditions and, in particular, a pleasant feeling of freshness, are as follows: environment at a temperature above that of the air, low air temperature compatible with full warmth, reasonable number of changes of fresh air per hour, and reasonable air movement. More controversial factors which are, however, fairly well recognized favour an incandescent source giving undirectional heating, variability of air movement, lack of uniformity of heating, and increase in air temperature from head to floor level. There is some evidence that radiation of certain wavelengths promotes a feeling of stuffiness or is trying to the eyes, whereas others promote freshness, and such factors are likely to be particularly important if an attempt is made to produce comfort by using a high radiant intensity to compensate for a very low back equivalent temperature.

These principles of comfort heating indicate clearly the desirability of a reasonable air temperature with additional radiant heat, and the problem is to obtain such results economically in the British climate.

Comfort Heating in Britain

Domestic heating in Britain is often criticized as being inadequate in comfort and extravagant in the use of coal considering the mild

climate. These criticisms have been due to the widespread use of an inefficient open coal fire, giving an unnecessarily high air change, floor draughts, and almost the whole of its output as radiant heat. Unsatisfactory heating in the past has not only been due to inadequacy of the total heat available but also the lack of appreciation of the need for an adequate air temperature and a back equivalent temperature of at least 56° F. before comfort can be established in a living room.

The main characteristics of the heating season for the South of England are that the period extends for almost 30 weeks; the average outside temperature is about 42° F.; the minimum temperature rarely drops below 30° F. for more than a few days; conditions are often damp and depressing; and rapid variations of outside temperature are common. Table II gives some of these characteristics in more detail.

TABLE II

No. of weeks	Outside air temperature		Inside air temperature (unheated)		Inside air temperature (room heated previous day)	
	°F.	°C.	°F.	°C.	°F.	°C.
7	30-40	—1.1-4.4	35-45	1.7-7.2	40-50	4.4-10
7	40-45	4.4-7.2	45-50	7.2-10	50-55	10-12.8
8	45-50	7.2-10	50-55	10-12.8	55-60	12.8-15.6
8	50-55	10-12.8	55-60	12.8-15.6	60-65	15.6-18.3

The last column is based on tests carried out in three rooms of normal brick construction in which heating took place for eight hours a day.

The inside air temperatures suggest that during 16 weeks radiant heat could give immediate comfort on occupation, but during the coldest 14 weeks the inside air temperature must be raised before comfort is obtained.

It is difficult to compare the effect on air temperature of equivalent heat outputs of radiant and convected heat as the lining of the walls and the amount and type of furniture affect the result, but tests suggest that any difference is not marked under equilibrium conditions although radiant heating may be appreciably slower during the heating-up period of the room. It is also not always possible for the occupant to take full advantage of the radiation available and it seems desirable to use convection heating to give some uniform heating of the house and to increase the initial temperature of a room in the really cold weather, providing this can be done economically. Table III shows the relatively small heat requirements needed to maintain a room, or a house, at a temperature of only 45° to 50° F. (7.2° to 10° C.).

TABLE III

Inside air temperature		Degree days*	Relative heat requirements
°F.	°C.		%
45	7.2	250	7
50	10	600	16
55	12.8	1,400	37
60	15.6	2,400	63
65	18.3	3,750	100

* *Guide to Current Practice*, Inst. of Heating and Ventilating Eng., 1940. 60° F. is taken as base temperature for a room temperature of 65° F. 1 degree day = No. of degrees difference over 1 day between the base temperature and the daily outside temperature when the latter is below the base temperature. The annual total of degree days is the sum of the degree days for all days of the year.

On such general grounds the trend in design of gas heating appliances has been to introduce background heaters of low heat output, giving nearly all their heat as convected heat, in order to give uniform general heating in the whole house and in the living room; and also convector gas fires giving a suitable proportion of convection to radiant heating for the complete heating of a room. These appliances, additional to the conventional gas fire giving radiant heat for topping-up purposes, have the advantage of an increase in total efficiency compared with the radiant fire.

The aim of modern gas heating is to increase the total amount of heat available in the house in the colder weather by increasing the total thermal efficiency of the appliances, to take advantage of flexibility of output, to produce the minimum standard of comfort as speedily as possible after occupation, and then allow the room to heat up to obtain full comfort.

Characteristics of Gas Space Heating Appliances

These can conveniently be considered from the following points of view: the thermal efficiency, which affects the fuel economy directly; the proportion of radiant to convected heat, which affects directly the uniformity of heating; the radiant distribution characteristics, which affect the shape and area of the zone of comfort in a room; and the emission spectrum, which may directly affect the degree of comfort.

Heat Input, Efficiency, and Proportion of Radiant to Convected Heat

Table IV summarizes these values for heaters normally used for domestic purposes—the values for efficiency do not include any extra heating obtained from an internal flue.

TABLE IV

Type of heater	Maximum heat input B.Th.U./hr.	Thermal efficiency	Proportion of radiant to convected heat
		%	
Flued fire	10,000-20,000	45-50	20
Flued convector fire	15,000	60-65	3
Flueless fire... ...	2,500-6,000	90	0.3-0.4
Flueless radiator ...	5,000-10,000	90	0.1-0.3
Flueless background heater	2,000-4,000	90	0.05

The convector fire or a combination of a flued fire and a flueless heater shows a marked increase in thermal efficiency compared to a purely radiant fire. The convector fire has the merit that only the one unit has to be supplied, whereas the use of the combination of appliances has the great advantage that the flueless heater can be used independently to give background heating.

Distribution Characteristics of Radiant Heaters

Different distributions result from: the shape, type, and angle of the radiants; the height of fixing of the fire from floors; and the use of reflectors. The choice of distribution will, to some extent, be a matter of individual preference as it will affect appearance. Distribution also affects the proportion of the total radiation reaching an occupant directly; the positioning of occupants around the fire to obtain the desired intensity of radiation; and the relative heating of different parts of the body.

Interpretation of such figures is complex as the intensity needed for comfort will depend on the air temperature and also, particularly for full comfort, individual preferences.

Generally speaking, a wider distribution is desirable in a room occupied by several people for long periods, such as a living room, than that needed in a room in which a few occupants need comfort for a short period, such as a bedroom. The lower air temperature likely in a room occupied for short periods also makes a high intensity desirable.

Table V gives typical values for different classes of fire.

TABLE V

Type of fire	Heat input B.Th.U./hr.	Horizontal radiant—intensity B.Th.U./sq.ft./hr. Directly in front of fire						45° to side of fire					
		3 ft. away			6 ft. away			3 ft. away			6 ft. away		
		Height above floor level						Height above floor level					
		1ft.	3ft.	5ft.	1ft.	3ft.	5ft.	1ft.	3ft.	5ft.	1ft.	3ft.	5ft.
Hearth—vertical	15,000	380	270	115	95	85	70	225	160	55	55	55	40
Hearth—vertical	7,500	170	120	55	45	40	30	100	75	25	25	25	20
Hearth—inclined	15,000	350	290	155	88	85	70	260	210	95	65	64	50
Inset—inclined	15,000	220	225	220	55	55	55	165	190	190	35	45	50
Panel (2 ft. from floor)	15,000	260	325	205	75	85	80	160	210	130	45	55	50

1 ft. = 0.305 m. ; 1 B.Th.U./sq.ft./hr. = 2.7125 kcal./sq.m./hr.

These figures should be compared with the values of 40 to 75 B.Th.U./sq.ft./hr. (108 to 203 kcal./sq.m./hr.) average horizontal radiant intensity already quoted for full comfort with a back equivalent temperature of 58° to 65° F. and the lower values for minimum comfort. It is clear that adequate radiant intensity is available with flued fires at well below their "full on" rating, provided the heat output is adequate to produce and maintain a reasonable air temperature. Special attention has been paid recently to the design of gas fires which will retain appearance and radiant efficiency down to an input of about 5,000 B.Th.U./hr. (1,260 kcal./hr.).

Emission Spectra of the Radiation

The quality of the radiation will depend primarily on the operating temperature of the fire, but the spectrum can be modified by the use of different types of coating giving selective emission. There is some evidence that comfort conditions are improved as the proportion of radiation below 3μ is increased but recent work suggests that there may be specific effects of freshness at wavelengths 2.3μ, 3.5μ, and 4.5μ, and of stuffiness at wavelengths 3.0μ, 4.1μ, and 4.7μ.

As such evidence is incomplete it was considered of interest to compare the spectra of a range of gas fires and that of an open coal fire burning brightly, as the quality of radiation from coal fires is traditionally satisfactory.

Tests were also carried out in which blindfold testers were asked to distinguish between the feelings of comfort from a coal and different types of gas fire under the same conditions of warmth comfort. The only people who could distinguish between the fires were those who were sufficiently expert to distinguish between the different types of distribution from fires of different shape.

The difference in spectra between a coal and a coke fire burning at their brightest do not appear to be great, and it is possible that any physiological effects are less important than the psychological effect of different appearances. It is possible to change the average radiating temperature of a gas fire by several hundred degrees without substantially affecting the radiant efficiency and it may be that the limiting desirable temperature is that which does not impose too severe conditions on the component refractories.

Some Practical Tests Using Gas Space-heating Appliances

Practical tests have been carried out on the comfort effect and relative economy of the following appliances: a flued radiant fire as the sole method of heating; a flued convector fire as the sole method of heating; a combination of a flueless background heater with a flued radiant fire for topping up. The background heater was rated to give a maximum air temperature rise of 15° F. The tests were carried out in rooms of conventional brick contruction; these were regarded as ready for occupation when the centre Globe thermometer reached 60° F. (15.6° C.) and the fires were controlled manually to maintain a centre Globe temperature of 68° F. (20° C.). A Double Eupatheoscope would have given results slightly more favourable to convection heating and would have been a preferable standard, but was not available at the time.

TABLE VI

Appliance	Relative fuel used compared to flued radiant gas fire					
	4 hr. occupation			8 hr. occupation.		
Outside temperature ...	30° F.	40° F.	50° F.	30° F.	40° F.	50° F.
Flued radiant fire (100%) ...	100%	100%	100%	100%	100%	100%
Flued radiant fire and background heater on continuously (83-90%)	106%	84%	—	94%	81%	—
Flued convector fire (75%)	93%	84%	70%	84%	74%	64%

Table VI summarizes some of the results obtained. The figures in brackets show the theoretical consumptions compared to a flued fire as calculated from the relative thermal efficiencies of the appliance or combination of appliances in equilibrium conditions.

Although tests on a wider scale are needed, the figures confirm a saving in fuel similar to that anticipated from the relative thermal efficiencies. These savings were accompanied by improved comfort conditions throughout the room as a whole, as the additional air heating resulted in a wider zone of comfort around the fire. The continuous use of the background heater was not only economical but it enabled comfort to be established more rapidly than with the radiant fire or convection fire alone and, in addition, gave the advantage of a reasonably warm room at all times of day and night.

Industrial and Commercial Space Heating

Convector heaters have normally been used to give uniform and unobtrusive heating, but when ceiling heights permit overhead radiant heaters to be used it is possible to obtain the desired uniformity of heating, and to give comfort at an air temperature 5° to 7° F. lower than that for an air heating system. The lower air temperature results in earlier comfort and reduced overall heat losses from the building.

The overhead heaters used are flueless, with the proportion radiant to convected heat of about 1:1, and may either radiate at about 650° F. (343° C.), or at incandescent temperatures.

Present experience suggests that for normal conditions the total radiation on an occupant from all directions at floor level should be 15 to 20 B.Th.U./sq.ft./hr. (55 to 74 kcal./sq.m./hr.), but it is still desirable to assess the number of heaters needed on the total thermal output of the heaters and the conventional heat losses from the building, assuming an air temperature 5° F. lower than that used for an air heating system. The heaters are then spaced, according to their distribution characteristics, to give uniform radiant heating on the floor. It is important to avoid overheating of the head and it is probable that the maximum intensity received by an occupant from any one direction at floor level should not exceed 20 B.Th.U./sq.ft./hr. The technique used for the distribution of lighting units can readily be adapted to the heating units.

Lines of Future Development and Research

Although there is general evidence that a combination of radiant and convected heating gives the nearest approach to ideal comfort and is economical in fuel, there is need for detailed information on the factors involved. A great deal of literature is available on uniform heating but very little on undirectional radiant heating in spite of the fact that this represents the normal method of heating in Great Britain.

It is felt that further information on the following problems is urgently needed:

(*a*) Theoretical and practical work on the effect of different proportions of radiant to convected heat on the heat input needed to give the same level of warmth comfort for normal domestic heating. Several types of building construction, including low heat capacity linings, should be covered.

(*b*) The intensity of radiant heat needed for minimum and full comfort using undirectional sources and uniform heating at different air temperatures. The effect of emission spectra on these values should also be determined.

(*c*) The maximum permissible radiant intensity, total and in any one direction, for overhead heating.

(*d*) The factors affecting ideal comfort conditions as opposed to mere warmth comfort, with special reference to the value of changes of fresh air and the quality of the radiation.

[1] *Journ. Inst. Fuel*, Wartime Bulletin, 1944, 17, 41.

[2] A. L. Roberts and R. Long, "First Report on Radiant Heating," 46th Report Joint Research Committee Gas Research Board and University of Leeds (G.R.B.15).

[3] "Recent Developments in Radiant Heating for Industrial Processes," *Gas*, 1947, i, 5, 356.

[4] "The Influence of Natural Convection on the Effectivness of Radiant Heating," *Gas Times*, 1945, xliv, 573, 55.

[5] *Nature*, clxiv, 62, 1940, J.I.H.V.E., Sept., 1940, and work shortly to be published.

GAS METERS IN THE BRITISH ZONE OF GERMANY AND IN BERLIN*

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This Paper is based on B.I.O.S. Report No. 913 having the same title and issued under the authority of the British Intelligence Objectives Sub-committee.

I would like, first of all, to remind you, as we did the readers of our Report, that in Germany during the war years, little was done in the development of gas meters. This will not surprise you, since you know of what took place in this country; it could hardly be expected that scientific and technical brains would be devoted to developments in the gas meter field when so much of that effort was required in the prosecution of the war.

Probably the most interesting development in the German gas meter industry has been the design and production of the plastic meter at Hamburg gas-works. Work on this meter started in about 1936 and it was intended that practically the whole meter should be constructed of plastic material.

Here it may perhaps be convenient to mention a further interesting feature of German gas meters. In the majority of designs of meter the leathers are contained in separate measuring compartments around which the meter case is built. The leathers do not move openly within the meter case as in the designs found in this country.

I would not attempt to evaluate the comparative advantages of either method, even if I were competent to do so. It appears to me to be a matter for the consideration of the meter makers in this country and they may already have formed their opinion on this matter. Be that as it may, the Hamburg plastic meter is one of this type and was intended as originally designed to have both the leather compartments and the outer case constructed of plastic. In fact, owing to the shortage of plastic moulding powder, the outer case is now made of soldered sheet and the plastic material is reserved for the leather compartments and for other smaller components of the meter, such as the valve plate and gratings and the valve covers and top mechanism.

Another meter to which I should like to refer is that made by Vesta in Berlin. This meter has only a single diaphragm with poppet valves, a design of meter which is by no means uncommon in Germany.

* From a Paper at the Annual Conference of the Institute of Statutory Inspectors of Gas Meters, Brighton, on Sept. 24-25, 1947.

An interesting feature of the Vesta is, to my mind, the device for transmitting the lever action arising from the movement of the leather to the counting index. We tested one of these meters on our return and although the results obtained are quite reasonable (they are reproduced in the Report) it appears to me to be doubtful whether either meter makers or gas undertakers in this country would approve of the loud "grandfather clock tick" which the meter emits while working at its rated capacity.

We wondered when we went to Germany whether we would learn anything of interest with regard to substitutes for leather in the meter diaphragms since it was to be expected that this material would be generally in short supply. In brief, it appeared that the stocks of leather in Germany had held out reasonably well during the war and that little attention had been paid to substitutes. Those that had been tried had been found to be unsatisfactory under the conditions in which they were expected to work. They had not good wearing qualities; were too stiff in cold weather; or were too heavy and variable. Some were acted upon by constituents in the gas. It appeared to us to be significant that the Hamburg Gas Company, who to all appearances are, at present, the foremost exponents in meter design and construction, have given little thought to substitutes for leather.

Coin Mechanisms

Turning now to coin mechanisms, we find that although the prepayment meter is by no means so extensively used in Germany as it is in this country considerable attention appears to have been paid to the development of the coin mechanism.

At Hamburg we saw a prepayment mechanism and coin box which is capable of attachment to the outlet of an ordinary meter without its removal, so that an ordinary consumer who wishes to become a prepayment consumer, or *vice versa*, can do so without the exchange of his meter. Kromschröder have developed as one unit a tariff prepayment mechanism whereby a certain fixed sum has to be paid into the meter before the meter valve opens and thereafter gas is purchased by the insertion of coins in the ordinary way. At Elsters in Mainz we saw what they call a "Karenza" box. This is a modified coin box which can take the place of the box on the normal prepayment meter

and which, in effect, converts the ordinary meter mechanism into a tariff mechanism.

Our terms of reference for our trip to Germany included the fitting of gas meters. No doubt more information in this direction would have been obtainable from the gas undertakers themselves. At Hamburg, where they are of course suppliers of gas as well as meter makers, they have for some years used a type of flexible connexion for the inlet and outlet of their meters. These consist of corrugated brass tubing with sockets soldered at each end. They enable the meter to be fixed without strain on the case, usually without a meter shelf.

Standardization

You may like to hear something with reference to the standardization of meters in Germany. In 1938, the Physikalisch-Technische Reichanstalt came to an agreement with bodies representing the gas undertakers and the meter makers that, as from July, 1940, only four sizes of meter would be manufactured for domestic purposes. These meters have capacities per revolution of 2, 5, 10, and 20 litres with a rate of working at the nominal capacity of 1,200 revolutions per hour. Here one may note that in Germany every meter is considered to have three "capacities":

(1) The nominal capacity—that is, what we know in this country as the "badged" capacity;
(2) The peak capacity, which is the maximum load to which a meter may be subjected, presumably for a short time; and
(3) The minimum capacity, which is the smallest load at which the meter must still conform to the registration requirements.

The nominal capacity may be so great as to equal the peak capacity and in any case must be not less than half the peak. The peak capacity and the minimum capacity define the testing range.

Returning to the four standard sizes decided upon, we see that the nominal capacities are 2.4, 6, 12, and 24 cu.m. per hour—that is to say, roughly, 85, 210, 420, and 840 cu.ft. per hour. The allowable peak capacities of these meters are, in the smallest size, double the nominal capacity—*i.e.*, about 170 cu.ft. per hour—and in the three larger sizes, about 370, 630, and 1,000 cu.ft. per hour respectively. At the peak capacity the rate of operation of the meter rises from 1,200 to 2,400 revolutions per hour in the smallest meter and to 1,500 revolutions per hour in the largest. Thus you will see that these four standard sizes of meter are adequate to cater for any likely domestic requirements.

Together with this standardization of capacities of meter there has been also of course a standardization of the more important dimensions of the meter, for example, the distance between the centres of inlet and outlet and the size of the connexions; these are fixed for each size of meter, and, in addition, maximum dimensions are laid down in each size for the distance from the bottom of the meter to the inlet and outlet connexions, and from the centre of the connexions to the back of the meter.

Certification

Every type of meter before it is allowed to be used in Germany has to receive a certificate issued by the Physikalisch-Technische Reichanstalt, and this Department lays down regulations introducing certain requirements which a meter must fulfil before a certificate may be issued. Needless to say, before a certificate is issued the question of official testing does not arise. These regulations are made with respect to, for example, the markings which a meter must carry; the capacity per revolution; the materials of which the meter is constructed; the design of the index mechanism including the dimensions and values of the dial circles; the dimensions and value of the test dial circle; coin mechanisms; the diaphragms of the meter; lubricating devices; the meter valves; the limits of error allowable; the position of the stamp; and the seals which are required. The main requirements affecting dry gas meters are given in an Appendix to B.I.O.S. Report No. 913.

What I have just said concerns the meter before it reaches the official inspector. We saw two official testing stations, one on the premises of the gas undertaking at Hannover and the other at the works of a meter manufacturer. The most striking thing about them was, I think, the complete access to the testing station allowed to the gas undertaker or meter maker during the absence of the official inspector. The apparatus was in fact used for maker's or repairer's tests as well as for official testing.

The apparatus used in meter testing follows closely that in this country. The holder is, however, of much lighter construction than is the case with those to which we are accustomed. The tank is constructed of mild steel, riveted or welded, and its rim is stiffened by a wrought iron flange. The bell is made of either copper or tinned iron sheeting. Compensation for the buoyancy of the bell is obtained by the "chain" method; the so-called "cycloid" is apparently not favoured in Germany.

In testing meters it appears to be quite the normal practice to run as many as five or six in series, and air is used throughout. Apart from the registration tests, a test for soundness is of course applied and also a test for passing unregistered gas. We were unable to obtain the official requirements in respect of these tests nor could we ascertain the official limits for pressure absorption, although I have reason to believe that they are practically identical with those in this country. It is the case, however, that official limits are set down also for oscillation of pressure; the maximum allowable oscillation appears to be about half the permitted pressure absorption.

Before concluding this Paper I will very briefly mention two other subjects in which I know you are interested.

Testing Meters of Large Throughput

Although we were unable to go thoroughly into the official testing of meters in Germany, I made it a practice to enquire of every likely person I met the method adopted in Germany of testing meters of large throughput. We have this problem in this country and I was anxious to find out if the Germans could tell us anything. The short answer appeared to be that they could tell us nothing. Almost invariably in proving large meters, series running with large wet meters and with meters of the Connersville type was employed. Nowhere were they able to show us any method of verifying a large meter at its rated capacity against an ultimate standard of volume. Mention should, however, be made of two large test holders used by Kromschröder before the war which had a capacity of about 140 cu.ft. each. These holders were destroyed by air attack and were therefore not to be seen.

The other subject which I will mention is that of periodical reverification of meters; only to inform you that in Germany, as far as we could tell, there is no compulsory reverification. The Berlin Gas Company, and probably one or two others, have considered adopting reverification as a matter of general policy; in the case of Berlin the interval between tests was proposed to be five years.

To conclude this Paper, may I merely give you in summary form what appear to be the chief items of interest to do with gas meters, arising out of our visit to Germany (some of these I have not mentioned in this Paper). They are:

(1) The use of plastic components in certain meters.
(2) The enclosing of the meter leathers to form defined measuring chambers.
(3) The standardization of four sizes of domestic meter.
(4) The lack of attention paid to substitutes for meter leathers.
(5) The use of certain materials in the manufacture of valve covers and slides.
(6) The almost general use of direct reading indexes.
(7) The apparently universal adoption of the "open top" meter.

TRAINING OF THE ILLUMINATING ENGINEER

IN the course of his Presidential Address to the Illuminating Engineering Society Dr. **J. W. T. Walsh** said:

"Ever since the foundation of the Illuminating Engineering Society in 1909 membership of that body has been open to anyone interested in the subject of illumination. The Society is cultural in character and no attempt has been made to join the ranks of the professional institutions. Recent progress in the art and practice of illuminating engineering has, however, been so great that there has arisen a new profession, that of the illuminating or lighting engineer.

"The first effect of this on the structure of the Society was the institution in 1940 of Fellowship of the Society. This departure, however, did not meet the need for a hall-mark of the competent lighting engineer, a hall-mark which would be of great benefit not only to the holder but to those wishing to distinguish the expert from the incompetent. The Society was therefore faced with the problem of either admitting to membership only the professional lighting engineer, thereby changing the basis on which it had worked so long and so successfully, or alternatively retaining its cultural status and make no attempt to apply any professional hall-mark to those of its members engaged in this new and growing branch of engineering. Fortunately a compromise has been found by which the required distinction can be applied without affecting the conditions of membership to the Society.

"In order that this hall-mark shall be of the greatest possible value not only to the holder, but to the Society and to the world at large, the basis on which it is granted needs the most careful thought. The first point to be considered is, of course, What are the qualifications expected of the competent lighting engineer. Apart from a good educational background he must have a sound knowledge of the fundamentals of light, mathematics, and electrical or gas engineering. It cannot be too strongly emphasized that early specialization in illuminating engineering, before an adequate background in all the basic subjects has been obtained, can only lead to difficulties at a later stage. He must also know the principles that underlie the practice of his chosen profession. In other words, he must have at least enough knowledge of the theory of the subject to be able to pass the Intermediate Grade of the City and Guilds Examination.

"It is to be hoped that the Society will pitch its demands high. It is important that the profession should quickly come to be recognized as one demanding a severe discipline on the part of those entering it who should be prepared for at least five years of part-time study on the theoretical side, after obtaining the School Certificate, and for a practical training covering that period and at least three further years of more advanced and responsible practice under the eye of a qualified lighting engineer.